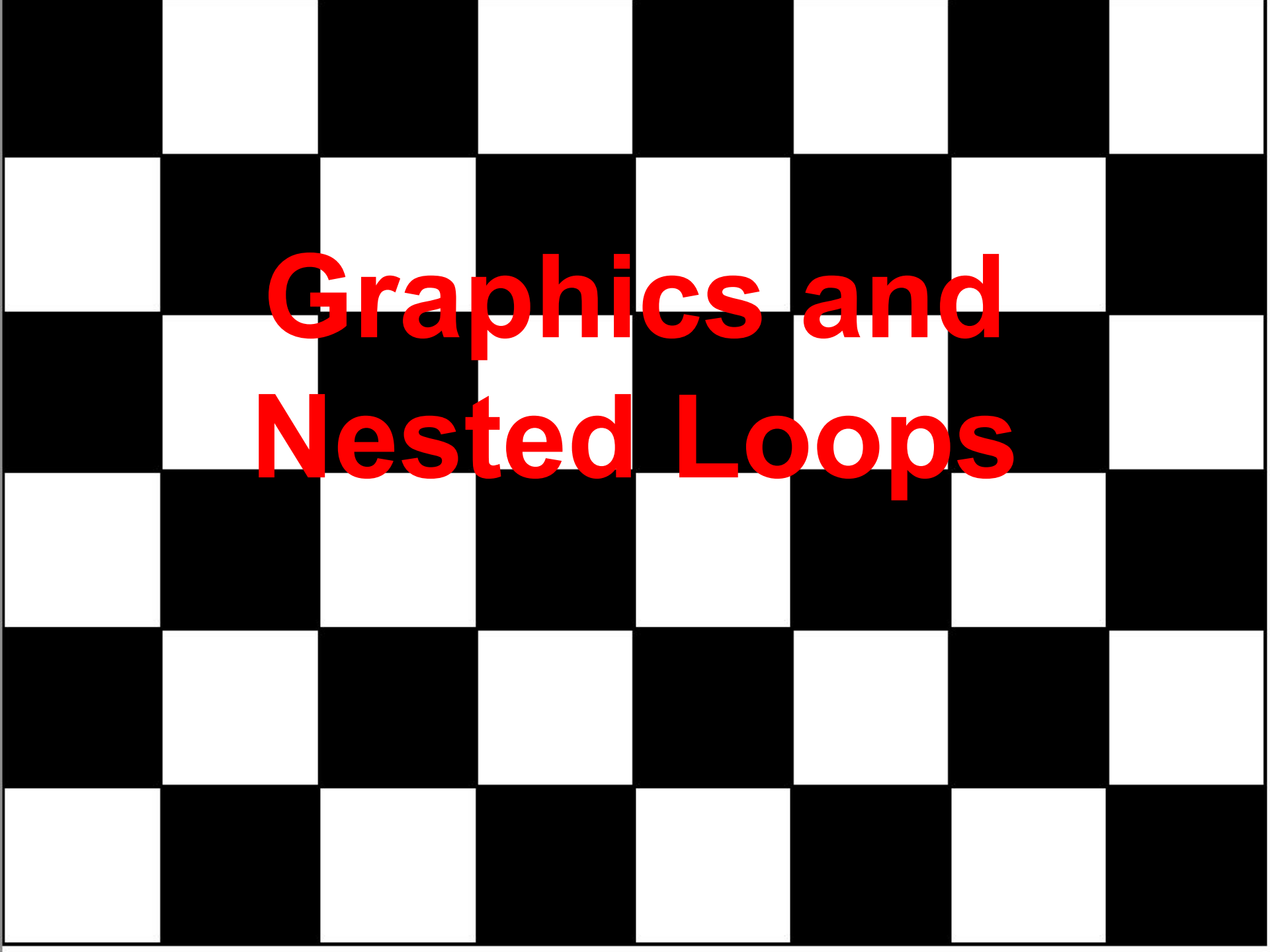

Graphics and
Nested Loops

Review

```
NUM = 5

for i in range(NUM):
    print("i = " + str(i))
```

index variable

```
i = 0
i = 1
i = 2
i = 3
i = 4
```

Nested Loops

```
print(0)
```

```
0
```

Repeat? A line?

```
for j in range(3):
    print(j, end='')
```

```
012
```

```
for j in range(3):
    print(j, end='')
```

```
012
```

Repeat? More lines?

```python
for i in range(4):
    print(str(i) + ":", end='')
    for j in range(3):
        print(j, end='')
    print()
```

```
0:012
1:012
2:012
3:012
```

```
for i in range(2):
    print(str(i) + ":", end='')
    for j in range(2):
        print(j, end='')
    print()
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):
        print(j, end='')
    print()
```

```python
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):
        print(j, end='')
    print()
```

```
0:
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):  j: 0
        print(j, end='')
    print()
```

```
0:
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):  j: 0
        print(j, end='')
    print()
```

```
0:0
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:0
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
```

```
for i in range(2):  i: 0
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
1:
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 0
        print(j, end='')
    print()
```

```
0:01
1:
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 0
        print(j, end='')
    print()
```

```
0:01
1:0
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
1:0
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

```
0:01
1:01
```

```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

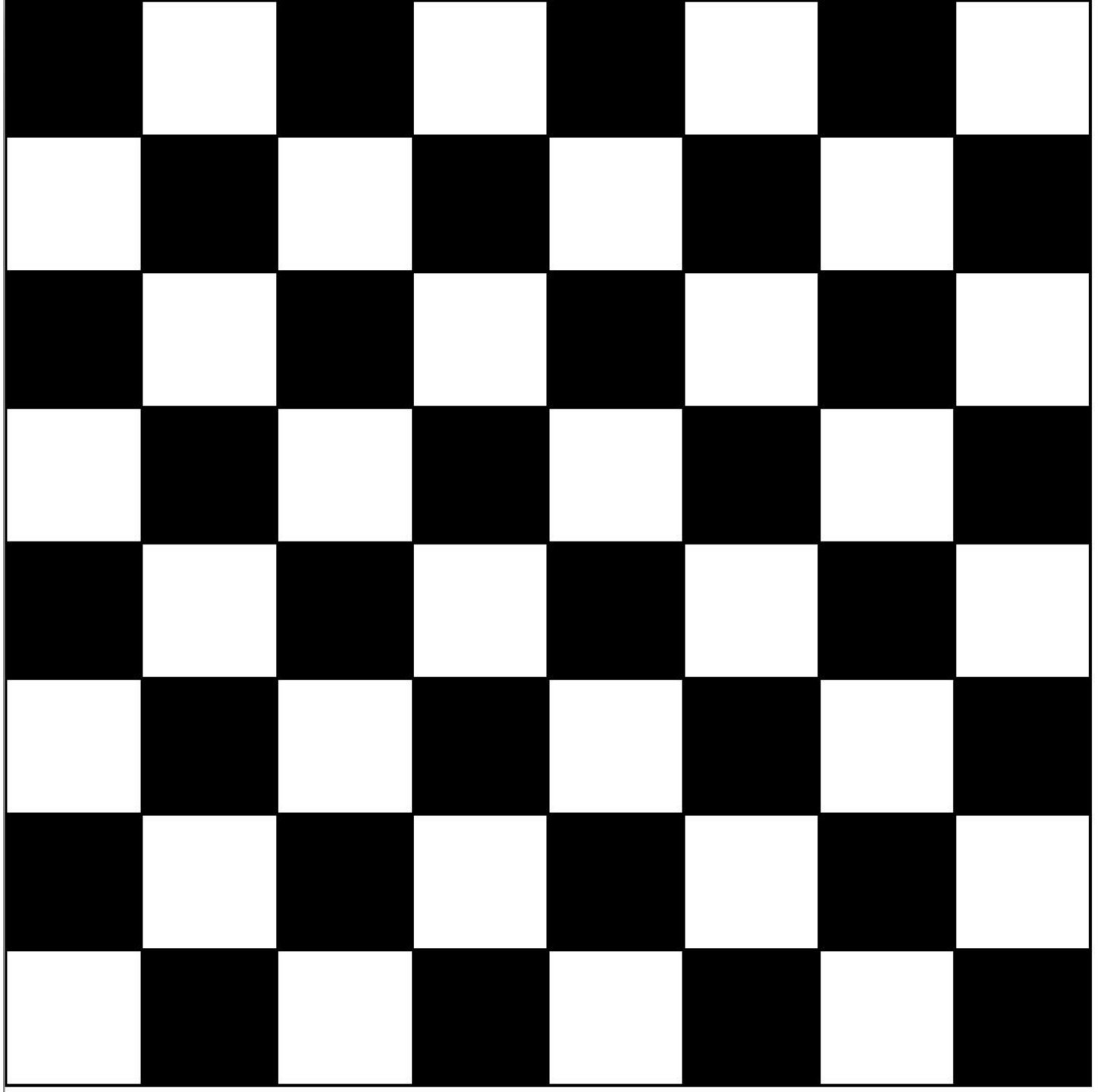
```
0:01
1:01
```

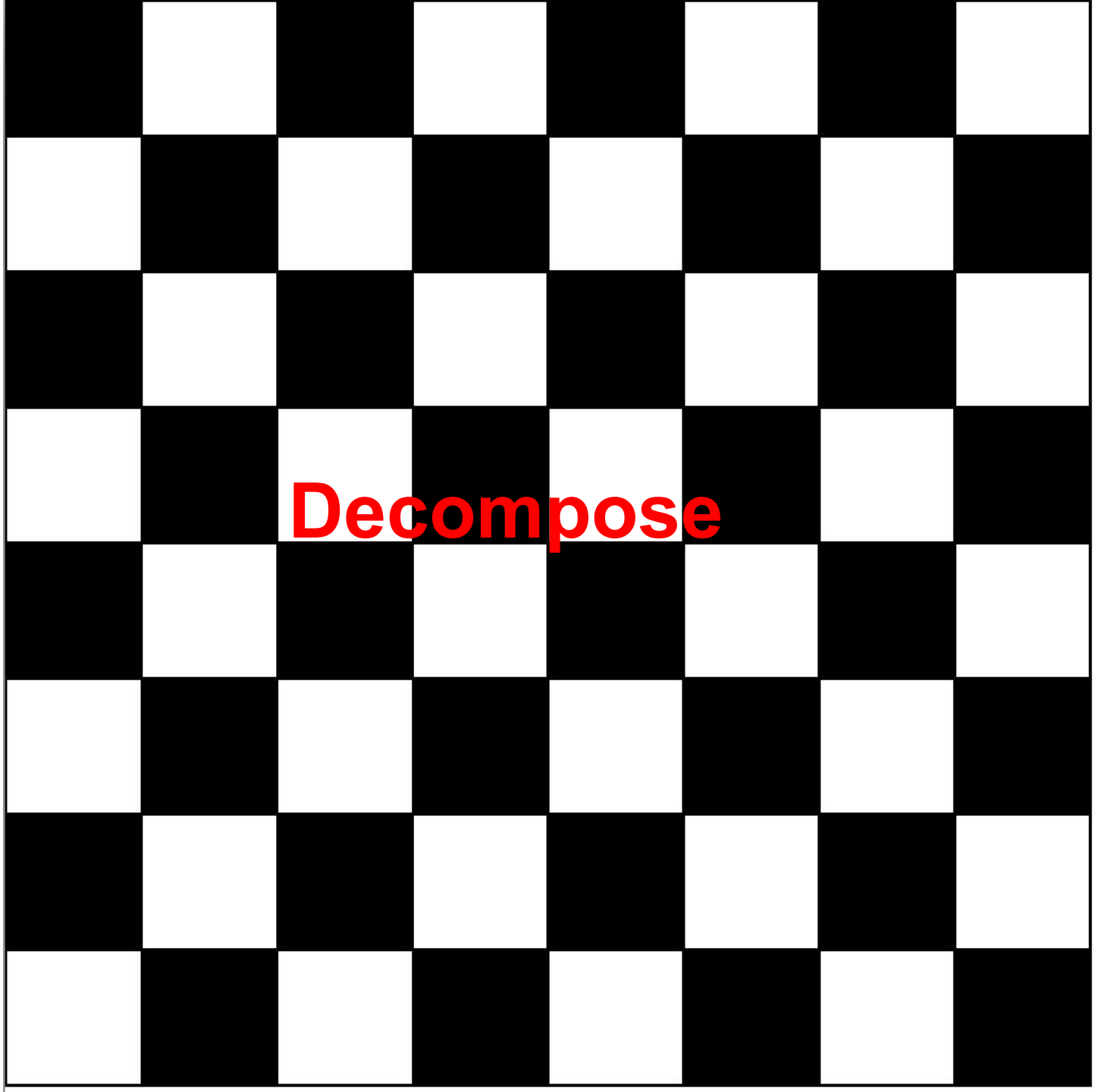
```
for i in range(2):  i: 1
    print(str(i) + ":", end='')
    for j in range(2):  j: 1
        print(j, end='')
    print()
```

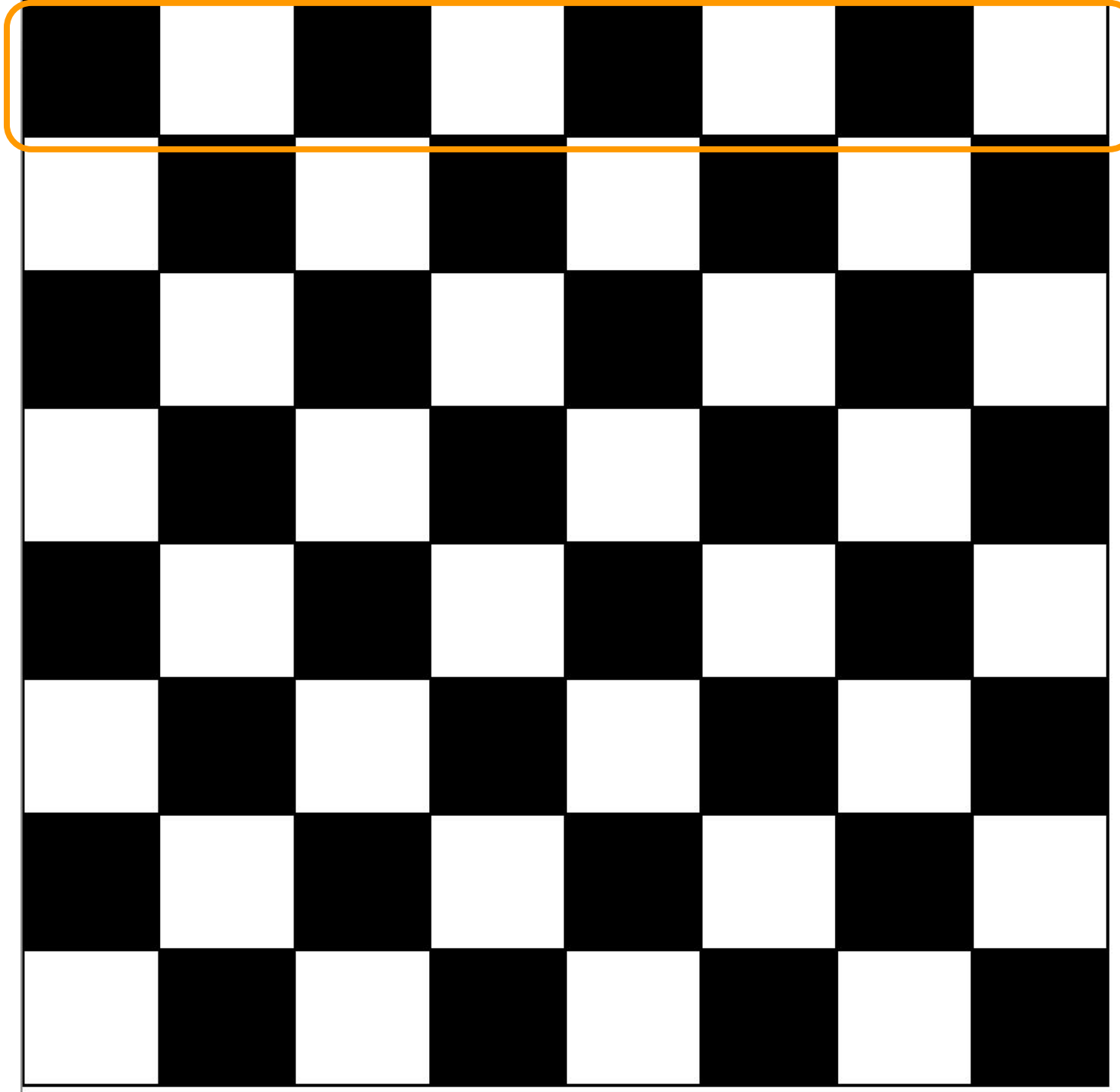
```
0:01
1:01
```

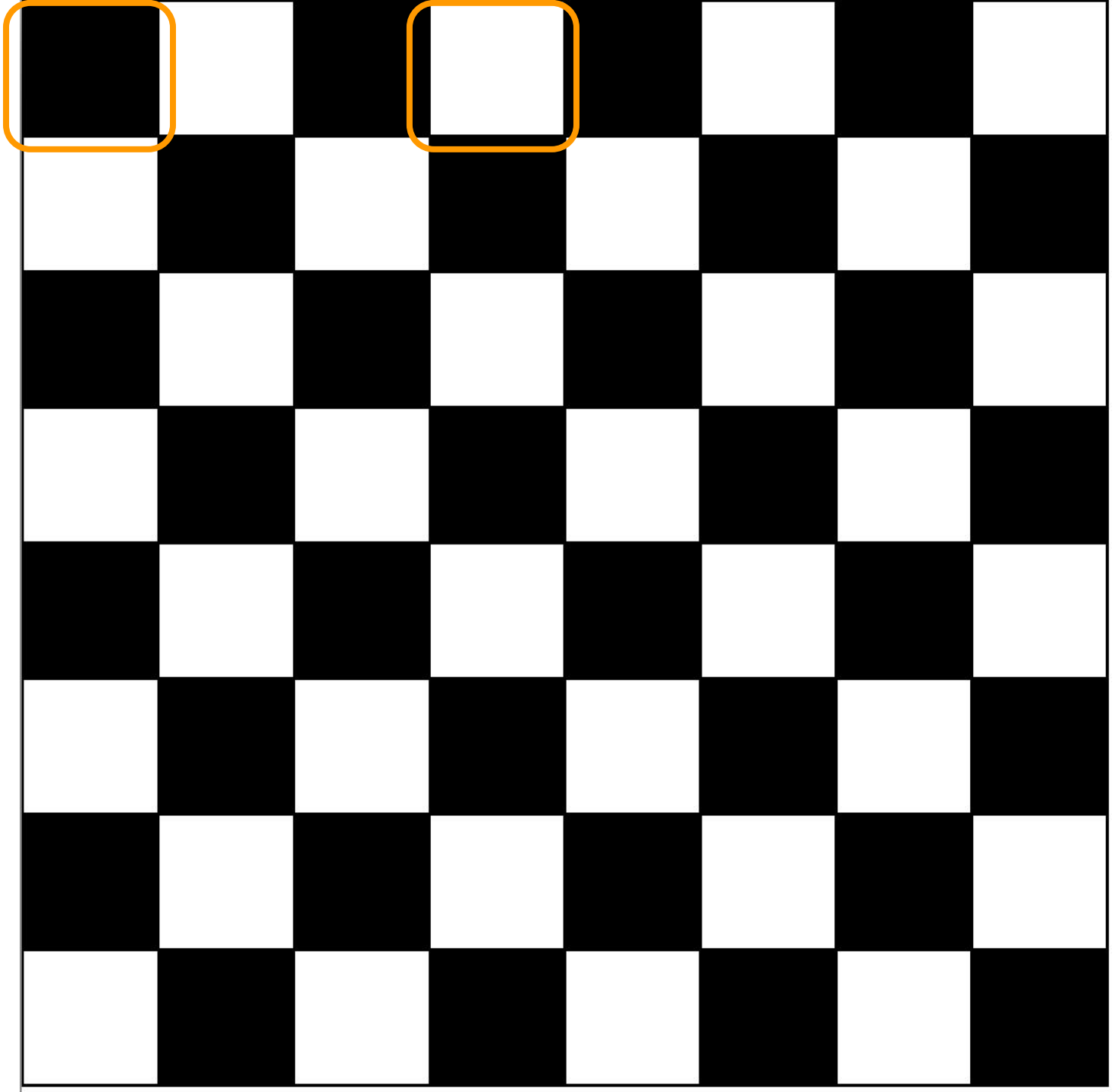
```python
for i in range(2):
    print(str(i) + ":", end='')
    for j in range(2):
        print(j, end='')
    print()
```

```
0:01
1:01
```

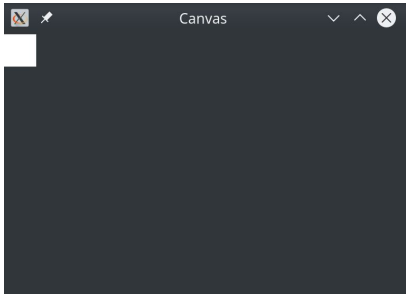



Decompose





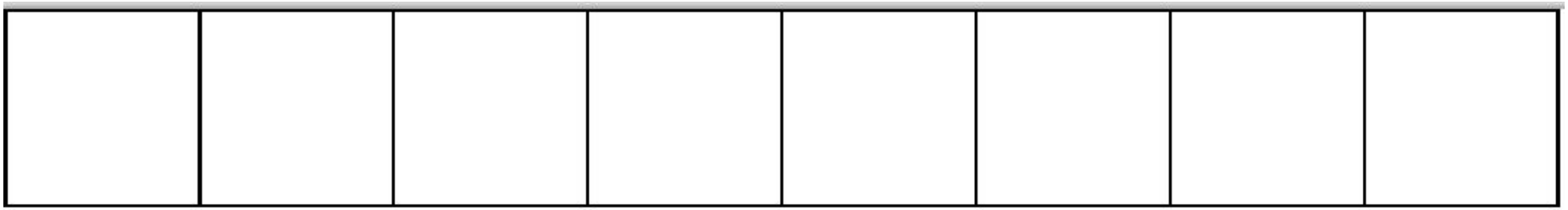
```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    draw_white_square(canvas)
    canvas.mainloop()


def draw_white_square(canvas):
    square = canvas.create_rectangle(0, 0, SQUARE_SIZE, SQUARE_SIZE)
    canvas.set_color(square, 'white')
```



```
def draw_white_square(canvas):
    square = canvas.create_rectangle(0, 0, SQUARE_SIZE, SQUARE_SIZE)
    canvas.set_color(square, 'white')


def draw_black_square(canvas):
    square = canvas.create_rectangle(0, 0, SQUARE_SIZE, SQUARE_SIZE)
    canvas.set_color(square, 'black')
```

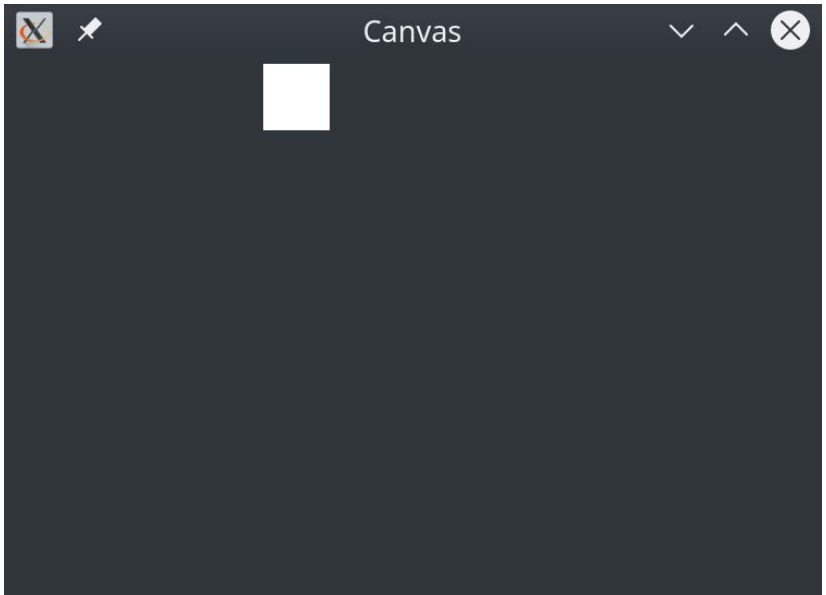
```
def main():
    canvas = Canvas()
    draw_square(canvas)
    canvas.mainloop()


def draw_square(canvas, black=False):
    square = canvas.create_rectangle(0, 0, SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

```
def main():
    canvas = Canvas()
    draw_square(canvas, black=True)
    canvas.mainloop()


def draw_square(canvas, black=False):
    square = canvas.create_rectangle(0, 0, SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```



```
def draw_square(canvas, x, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, 0, (x+1) * SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

```
def main():
    canvas = Canvas()
    draw_square(canvas, 4)
    canvas.mainloop()


def draw_square(canvas, x, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, 0, (x+1) * SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```



```python
def main():
    canvas = Canvas()
    draw_square(canvas, 4)
    canvas.mainloop()


def draw_square(canvas, x, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, 0, (x+1) * SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

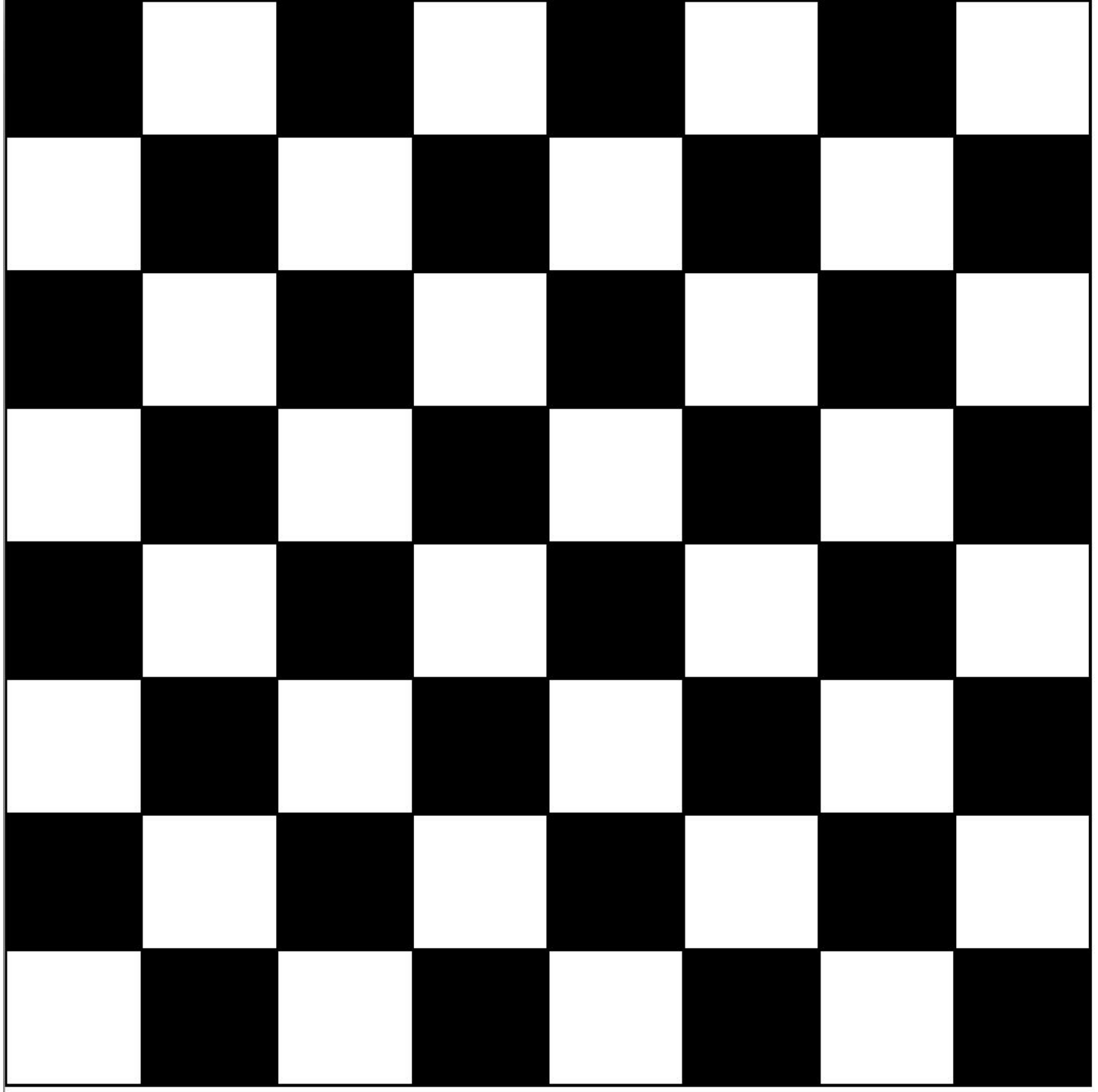
How to draw a line of white squares?

```
SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    for x in range(SQUARES):
        draw_square(canvas, x)
    canvas.mainloop()


def draw_square(canvas, x, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, 0, (x+1) * SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

```
SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    for x in range(SQUARES):
        draw_square(canvas, x)
    canvas.mainloop()


def draw_square(canvas, x, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, 0, (x+1) * SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

How to draw a line of altering black/white squares?

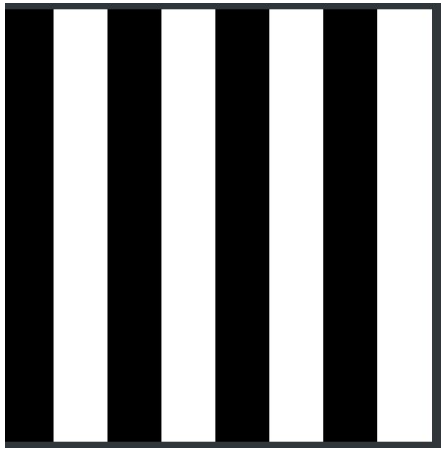
```
SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    black = True
    for x in range(SQUARES):
        draw_square(canvas, x, black)
        black = not black
    canvas.mainloop()


def draw_square(canvas, x, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, 0, (x+1) * SQUARE_SIZE, SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

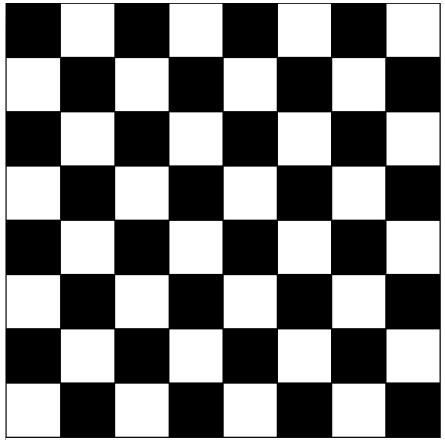


```
def draw_square(canvas, x, y, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, y * SQUARE_SIZE, (x+1) * SQUARE_SIZE, (y+1) * SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

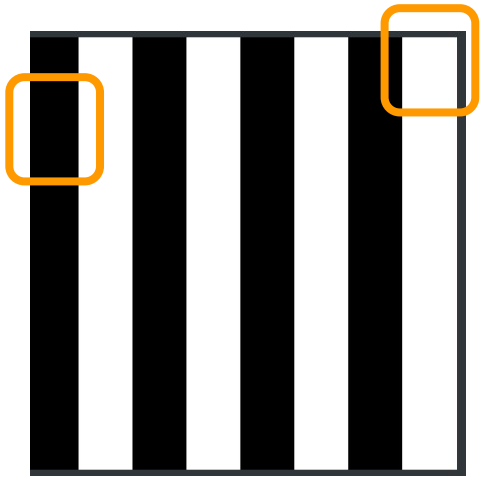
```
SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    black = True
    for y in range(SQUARES):
        for x in range(SQUARES):
            draw_square(canvas, x, y, black)
            black = not black
    canvas.mainloop()


def draw_square(canvas, x, y, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, y * SQUARE_SIZE, (x+1) * SQUARE_SIZE, (y+1) * SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```

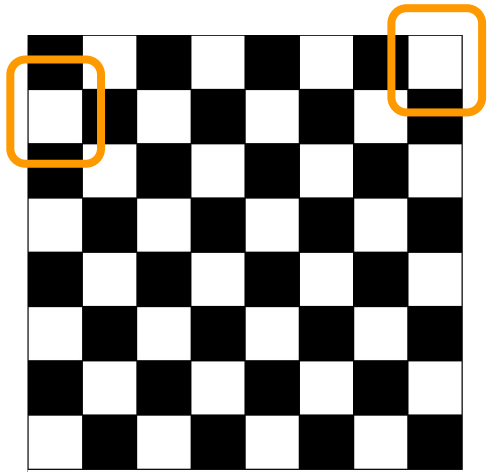
```
SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    black = True
    for y in range(SQUARES):
        for x in range(SQUARES):
            draw_square(canvas, x, y, black)
            black = not black
    canvas.mainloop()


def draw_square(canvas, x, y, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, y * SQUARE_SIZE, (x+1) * SQUARE_SIZE, (y+1) * SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```



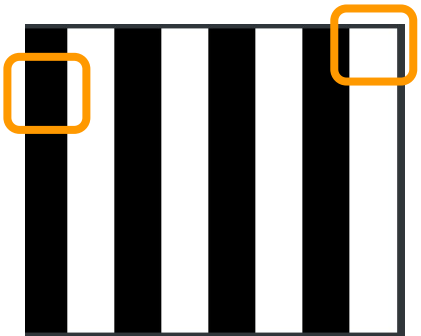


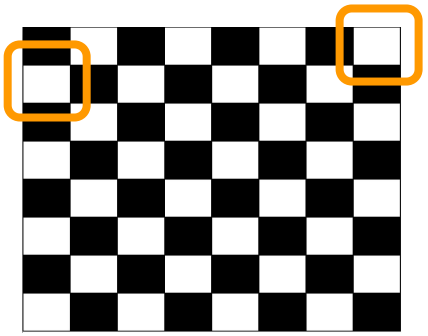
```
SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    black = True
    for y in range(SQUARES):
        for x in range(SQUARES):
            draw_square(canvas, x, y, black)
            black = not black
    canvas.mainloop()


def draw_square(canvas, x, y, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, y * SQUARE_SIZE, (x+1) * SQUARE_SIZE, (y+1) * SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```





```python
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 8


def main():
    canvas = Canvas()
    black = True
    for y in range(SQUARES):
        for x in range(SQUARES):
            draw_square(canvas, x, y, black)
            black = not black
        black = not black
    canvas.mainloop()


def draw_square(canvas, x, y, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, y * SQUARE_SIZE, (x+1) * SQUARE_SIZE, (y+1) * SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```



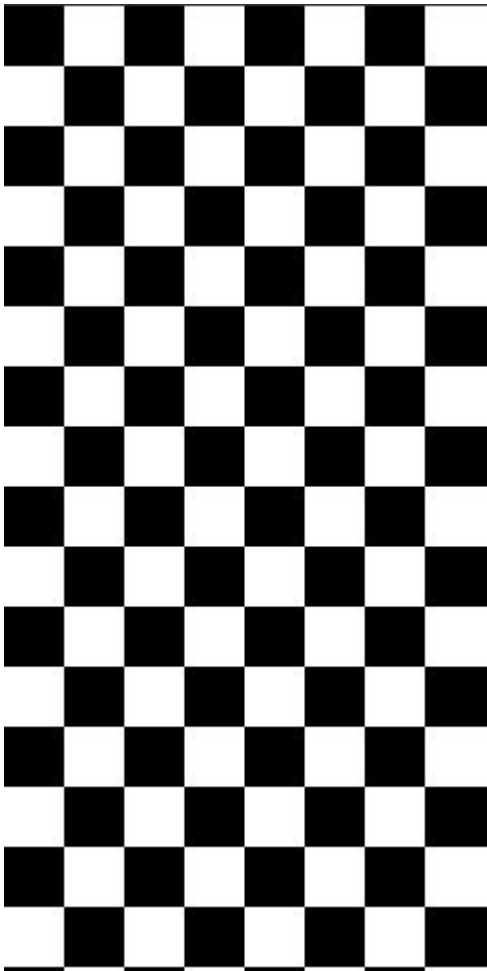


```python
from graphics import Canvas

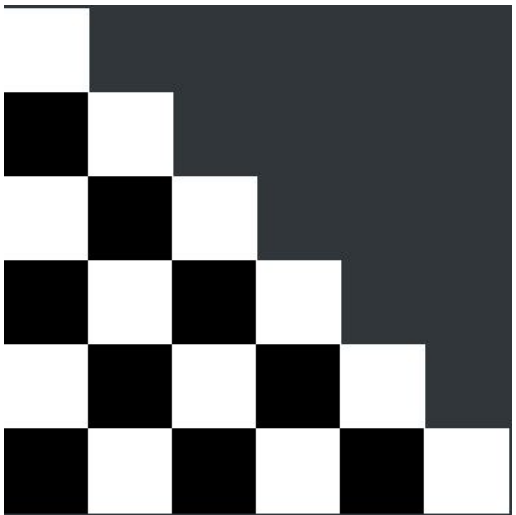
SQUARE_SIZE = 10
SQUARES = 8


def main():
    canvas = Canvas()
    black = True
    y = 0
    while y*SQUARE_SIZE < canvas.get_canvas_height():
        for x in range(SQUARES):
            draw_square(canvas, x, y, black)
            black = not black
        black = not black
        y += 1
    canvas.mainloop()


def draw_square(canvas, x, y, black=False):
    square = canvas.create_rectangle(x * SQUARE_SIZE, y * SQUARE_SIZE, (x+1) * SQUARE_SIZE, (y+1) * SQUARE_SIZE)
    if black:
        color = 'black'
    else:
        color = 'white'
    canvas.set_color(square, color)
```



```
def main():
    canvas = Canvas()
    black = False
    for y in range(SQUARES):
        for x in range(y+1):
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```



```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas:
    black = False  black: False
    for y in range(SQUARES):
        for x in range(y+1):
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: False
    for y in range(SQUARES):  y: 0
        for x in range(y+1):
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: False
    for y in range(SQUARES):  y: 0
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: False
    for y in range(SQUARES):  y: 0
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas:
    black = False  black: True
    for y in range(SQUARES):  y: 0
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: True
    for y in range(SQUARES):  y: 0
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas:
    black = False  black: True
    for y in range(SQUARES):  y: 0
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: True
    for y in range(SQUARES):  y: 1
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas:
    black = False  black: True
    for y in range(SQUARES):  y: 1
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: True
    for y in range(SQUARES):  y: 1
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas:
    black = False  black: False
    for y in range(SQUARES):  y: 1
        for x in range(y+1):  x: 0
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: False
    for y in range(SQUARES):  y: 1
        for x in range(y+1):  x: 1
            draw_square(canvas, x, y, black)
            black = not black
        if y % 2 != 0:
            black = not black
    canvas.mainloop()
```

```
from graphics import Canvas

SQUARE_SIZE = 60
SQUARES = 3


def main():
    canvas = Canvas()  canvas: .!canvas
    black = False  black: False
    for y in range(SQUARES):  y: 1
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            draw_square(canvas, x, y, black)
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        if y % 2 != 0:
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from graphics import Canvas

SQUARE_SIZE = 60
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def main():
    canvas = Canvas()  canvas: .!canvas
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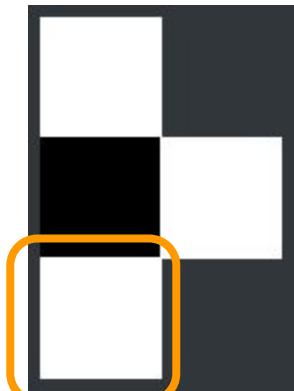

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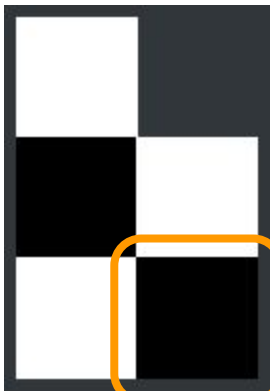

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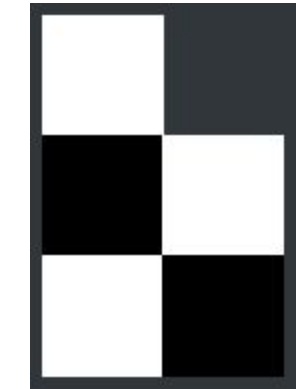

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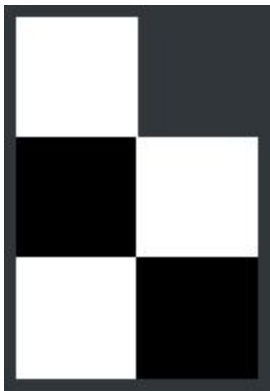

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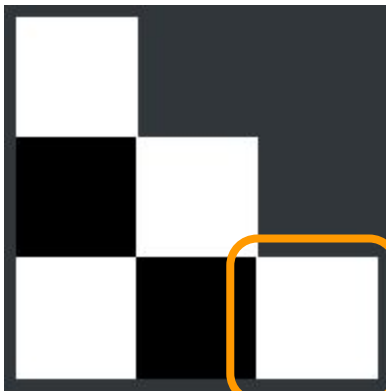

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